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Marshall Space Flight Center



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Fabrication of Magnetic Bubble Memory Overlay

The problem:

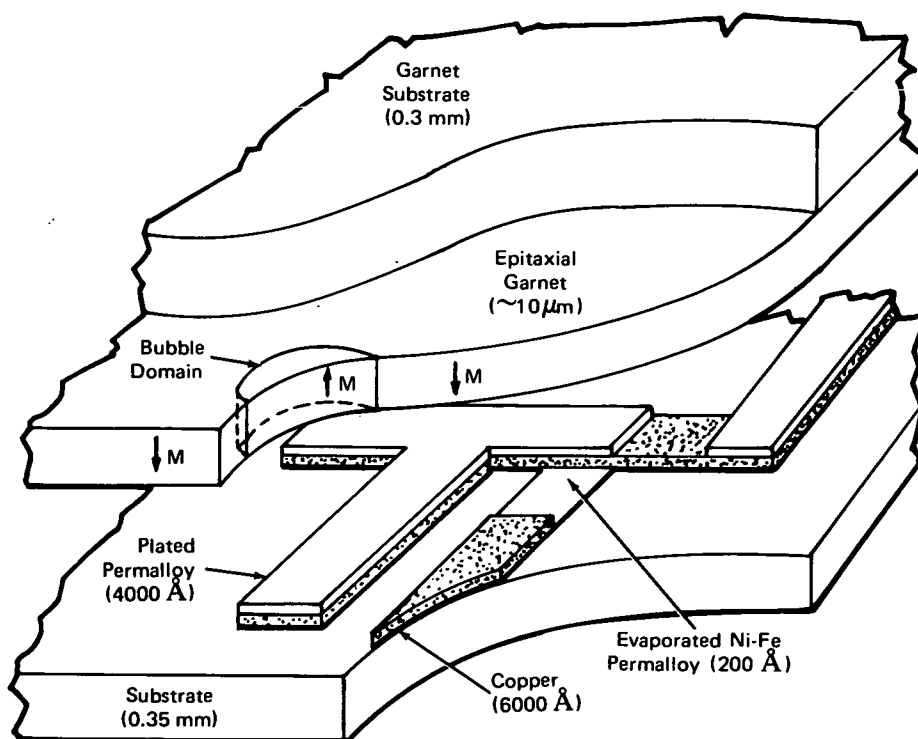
Magnetic bubble memories are a promising improvement over the ferrite core memories used in today's computers. Magnetic bubbles use low power and have a high density of data storage. However, in order to make bubble memories economically feasible it is necessary to devise an inexpensive method of fabricating a bubble overlay. The overlay must include all the functions needed in connection with generation, propagation, sensing, and annihilation of magnetic bubble domains.

The solution

A self-contained magnetic bubble memory overlay is fabricated by a new process that employs epitaxial deposition to form a multi-layered complex of magnetically active components on a single chip.

How it's done:

The chip structure is shown in the illustration. A glass substrate supports the overlay of thin permalloy magnetoresistive sensors, thick permalloy T-bars, and



Chip Structure

(continued overleaf)

the copper (or gold) conductor lines necessary for the operation of the memory chip. A single-crystal non-magnetic garnet substrate supports the thin epitaxial magnetic garnet layer which contains the bubble domains. The chip is completed by pressing the two substrates together while a small spacing is maintained between the permalloy layer of propagation and the epitaxial garnet layer.

The overlay fabrication comprises three metal deposition steps followed by a subtractive etch. A representative sequence is as follows:

Step 1 – A 200Å magnetoresistive film of Ni-Fe is deposited by evaporation onto a glass substrate in a dc in-plane magnetic field. This film is the plating surface for subsequent electro-deposition steps, and portions of it become sensors for the magnetic bubbles after the final etching.

Step 2 – The evaporated permalloy film is covered with positive photo resist ("positive" meaning that the area which has been exposed to light is removed during development). After exposure and development of the inverse of the desired conductor pattern, copper or gold conductors are electroplated in the exposed and developed-away areas.

In order to obtain a uniform conductor thickness for the overlay, the plating mask must be designed to properly balance the plated and nonplated areas. To that end, it is sometimes necessary to deposit the conductor in areas where it is not otherwise needed, but where it does not interfere with the operation of the final device.

A second requirement is proper pretreatment of the evaporated permalloy film before electroforming the conductor. For otherwise, copper and gold will not, generally, adhere well to iron or iron alloys.

Step 3 – A fresh layer of positive photo resist is applied, and an inverse pattern of the thick permalloy areas (T and I bars, generators, etc.) is exposed and

developed. Again the plated and nonplated areas must be balanced, and the exposed area pretreated as in Step 2.

Step 4 – The final, subtractive step serves to define the sensors and to separate the functional parts of the overlay. Three different methods can successfully remove the evaporated permalloy from unwanted areas and form the magnetoresistive sensors: chemical etching, electrochemical etching (back plating), and sputter etching.

Sputter etching gives the best yield, probably because it is the least selective and therefore easiest to control. In this method the evaporated permalloy is removed by conventional sputter-etching in an argon atmosphere. Since sputtering makes the photo-resist difficult to remove, it is left on to provide the spacing between the overlay and the bubble material and to protect against atmospheric corrosion.

Note:

Requests for further information may be directed to:
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Patent status:

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act [42 U.S.C. 2457 (f)], to IBM Corp, Huntsville, Alabama 35805.

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